

I CLAIM:

1. A remote plasma generator, comprising:
a microwave power source;
a microwave energy waveguide communicating with the power source, and configured to produce a travelling wave;
a plasma chamber configured to be mounted in fluid communication between a source of gases and a processing chamber;
a helical coil surrounding the plasma chamber; and
a coupler coupling the microwave energy from the waveguide to the helical coil.
2. The remote plasma generator of Claim 1, wherein the helical coil is formed of a hollow metal tubing.
3. The remote plasma generator of Claim 2, further comprising a pump circulating cooling fluid through the tubing.
4. The remote plasma generator of Claim 1, further comprising a cooling jacket surrounding the plasma chamber.
5. The remote plasma generator of Claim 4, wherein the helical coil surrounds the cooling jacket.
6. The remote plasma generator of Claim 1, wherein the microwave power source generates power at $2450 \text{ MHz} \pm 50 \text{ MHz}$.
7. The remote plasma generator of Claim 1, wherein the helical coil is configured to couple a travelling wave to gas travelling through the plasma chamber.
8. The remote plasma generator of Claim 1, wherein the plasma chamber is positioned upstream of a photoresist asher chamber.
9. The remote plasma generator of Claim 1, further comprising a microwave shield surrounding the plasma chamber and the helical coil.
10. The remote plasma generator of Claim 1, further comprising a microwave absorption load at an output end of the helical coil.
11. The remote plasma generator of Claim 1, wherein the coupler comprises a section of coaxial cable.

12. A method of delivering a plasma to a processing chamber, the method comprising:

providing a source of process gases in fluid communication with a plasma tube, said plasma tube being in fluid communication with a process chamber;

generating a travelling microwave signal;

propagating the travelling microwave signal along a microwave conducting structure having a section with a helical shape surrounding the plasma tube;

flowing a gas through the plasma tube such that a plasma is ignited in the gas; and

directing products of the plasma into the process chamber.

13. The method of Claim 12, further comprising providing a cooling jacket between the helical portion of the microwave conducting structure and the plasma tube and flowing a cooling fluid through the cooling jacket.

14. The method of Claim 12, further comprising tuning the microwave signal to a desired wavelength prior to propagating the signal along the microwave conducting structure.

15. The method of Claim 12, wherein generating a microwave signal comprises generating a signal with a frequency of about $2450 \text{ MHz} \pm 50 \text{ MHz}$.

16. The method of Claim 12, wherein generating a microwave signal comprises generating a signal with a power of between about 1300 W and about 1500 W.

17. The method of Claim 12, wherein the microwave conducting structure comprises a hollow-centered tube, and further comprising pumping a cooling fluid through the microwave conducting structure.

18. The method of Claim 17, further comprising isolating the cooling fluid from the microwave signal.

19. The method of Claim 12, further comprising a microwave shield surrounding the helical coil and the plasma tube.

20. The method of Claim 19, further comprising flowing a cooling gas through a space between the microwave shield and the plasma tube.

21. A method of removing a layer from a substrate, the method comprising:

flowing plasma source gases through a plasma reactor tube;

propagating microwave energy in a travelling wave along a microwave conducting structure having a shape of a slow wave structure and surrounding the plasma reactor tube;

igniting a plasma within the plasma reactor tube; and

flowing plasma products into a process chamber to impinge on a substrate to remove a mask layer on the substrate.

22. The method of Claim 21, further comprising flowing a cooling fluid through a conduit adjacent the plasma reactor tube.

23. The method of Claim 22, wherein the conduit is a space between a microwave shield and a plasma tube.

24. The method of Claim 22, wherein the conduit is a passage through a hollow-centered material of the slow wave structure.

25. The method of Claim 22, wherein the conduit is a cooling jacket concentrically surrounding the plasma tube.

26. The method of Claim 21, wherein the substrate is a semiconductor wafer.

27. The method of Claim 26, wherein the wafer is silicon.

28. The method of Claim 27, wherein the layer is a photoresist material.